

pending in the application.

#### REMARKS

The rejections of Claims 1-12 under 35 U.S.C. § 102(b) as anticipated by, and under 35 U.S.C. § 103(a) as unpatentable over, CA 2,037,214 (Dotzauer et al), are respectfully traversed.

The present invention relates to the use of compositions which comprise reaction products of low molecular mass dicarboxylic or tricarboxylic acids with ammonia to produce moldings from finely divided materials.

As described in the specification beginning at page 1, line 9, prior art moldings from finely divided materials have suffered from various deficiencies. Among such prior art is EP-A445578, which is equivalent to Dotzauer et al and which, as described in the specification at page 1, lines 31-35, discloses boards made from finely divided materials such as glass fibers, whose binder comprises a composition comprising high molecular mass polycarboxylic acids and polyhydric alcohols, alkanolamines and/or polyfunctional amines. The water resistance of the boards obtained is not satisfactory.

As described above, Dotzauer et al employs a binder which comprises high molecular mass polycarboxylic acids. Indeed, Dotzauer et al disclose that their invention includes condensates of high molecular weight polycarboxylic acids (page 1, lines 29-30). Dotzauer et al disclose further that particularly suitable high molecular weight polycarboxylic acids are polymeric polycarboxylic acids that contain, as polymerized units, not less than 50 mol% of monomers which contain a carboxyl group, such as maleic acid and fumaric acid, and 50-95 mol% of one or more monomers such as styrene, ethylene, and acrylates or methacrylates of alkynols of 1 to 6 carbon atoms. (Page 2, lines 1-20).

The present invention differs from, and is not suggested by Dotzauer et al, on at least

two levels. The at least one polycarboxylic acid of Formula I herein is different from, and of a substantially lower molecular weight than, the high molecular weight polycarboxylic acids of Dotzauer et al. It is clear that the presently-recited polycarboxylic acid of Formula I is not polymeric. In addition, the present invention requires ammonia or at least one substance which releases ammonia. Dotzauer et al neither disclose nor suggest the presence of such a material.

For all the above reasons, it is respectfully requested that the rejections over Dotzauer et al be withdrawn.

The rejection of Claims 1, 4 and 12 under 35 U.S.C. § 112, second paragraph, is respectfully traversed. Regarding the term "finely divided", it is respectfully submitted that one skilled in this art, which involves producing moldings from finely divided materials, would understand the metes and bounds of the above-quoted term. Guidance is also provided in the specification at page 15, line 19ff and page 20, line 13ff. With regard to the term "unconsolidated sheetlike structures", this embodiment is described in the specification beginning at page 24, line 11. The term "unconsolidated" means that the fibers are unbonded but are then bonded, i.e., consolidated, upon heat curing of the inventive heat-curable composition. Regarding the term "temperatures above 120°C", the upper limit is clearly governed by a temperature necessary to cure but not high enough to cause any damage. In addition, guidance is provided in the specification at page 21, line 1ff and page 24, line 44ff. Regarding the definitions of X and Y, it is now explicit what was at least implicit, that X and Y can each be hydrogen but with various limitations, as recited in the claims. With regard to the term "or X and Y together are a  $\pi$  bond", its meaning would be well-known as a matter of elementary organic chemistry, as confirmed by Morrison & Boyd, *Organic Chemistry*, Allyn and Bacon, Inc., Boston (1959), pages 101-102 and 124-125, a copy of which is enclosed herewith. In other words, when X and Y together are a  $\pi$  bond, the bond between the two

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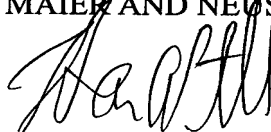
non-carboxyl group carbons in Formula I is a double bond.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

All of the presently pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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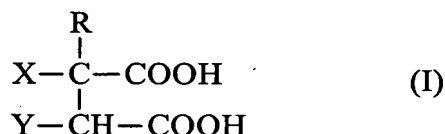
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IN THE CLAIMS

1. (Amended) a method for producing (1) moldings from finely divided materials [and for sheetlike structures of fiber materials], wherein the finely divided material is mixed or impregnated with a heat-curable composition and the resultant mixture is shaped at temperatures above 120°C or (2) consolidated sheetlike structures of fiber materials, wherein an unconsolidated sheetlike structure of fiber materials is first treated, with a heat-curable composition and then heated at temperatures above 120°C, wherein the heat curable composition comprises:

[-] (A) at least one reaction product of

i. at least one polycarboxylic acid of the formula I:



in which

R is a hydrogen or a CH<sub>2</sub>COOH group,

X is hydrogen, OH or NH<sub>2</sub>, but is OH or NH<sub>2</sub> if Y is hydrogen,

Y is hydrogen, OH or NH<sub>2</sub>, but is OH or NH<sub>2</sub> <sup>if</sup> ~~is~~ X is hydrogen, or

X and Y together are a π bond,

and/or an anhydride of the polycarboxylic acid I

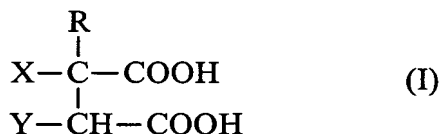
ii. with ammonia and, if desired,  
 iii. with primary amines and/or compounds containing at least two hydroxyl groups;  
 and/or

[-] (B) a mixture of at least one polycarboxylic acid of the formula I and/or its anhydride and at least one substance which releases ammonia on heating and, if desired, primary amines and/or compounds containing at least two hydroxyl groups.

12. (Amended) A heat-curable composition comprising

[-] (A) at least one reaction product of

i. at least one polycarboxylic acid of the formula I:



in which

R is a hydrogen or a CH<sub>2</sub>COOH group,

X is hydrogen, OH or NH<sub>2</sub>, but is OH or NH<sub>2</sub> if Y is hydrogen,

Y is hydrogen, OH or NH<sub>2</sub>, but is OH or NH<sub>2</sub> if X is hydrogen, or

X and Y together are a π bond,

and/or an anhydride of the polycarboxylic acid I

ii. with ammonia and, if desired,  
 iii. with primary amines and/or compounds containing at least two hydroxyl groups;  
 and/or

[-] (B) a mixture of at least one polycarboxylic acid of the formula I and/or its anhydride and at least one substance which releases ammonia on heating and, if desired, primary amines and/or compounds containing at least two hydroxyl groups; and

[-] (C) at least one further constituent selected from finely divided polymers of

ethylenically unsaturated monomers, compounds containing at least two hydroxyl groups, and polymeric polycarboxylic acids.

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# ORGANIC CHEMISTRY

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of the Alfred P. Sloan Foundation*

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*Boston*



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makes use of three equivalent hybrid orbitals:  $sp^2$  orbitals, formed by the mixing of one  $s$  and two  $p$  orbitals. They lie in one plane, that of the carbon nucleus, and are directed toward the corners of an equilateral triangle; the angle between any pair of orbitals is thus  $120^\circ$ . This trigonal arrangement (Figure 4.1) permits the hybrid orbitals to be as far apart as possible. Just as mutual repulsion among orbitals gives four tetrahedral bonds, so it gives three trigonal bonds.

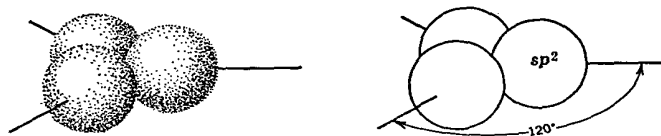


FIGURE 4.1. Atomic orbitals: hybrid  $sp^2$  orbitals. Axes directed toward corners of equilateral triangle.

If we arrange the two carbons and four hydrogens of ethylene to permit maximum overlapping of orbitals, we obtain the structure shown in Figure 4.2. Each carbon atom lies at the center of a triangle, at whose corners are located the two hydrogen atoms and the other carbon atom. Every bond angle is  $120^\circ$ . Although distributed differently about the carbon nucleus, these bonds individually are very similar to the bonds in ethane, being cylindrically symmetrical about a line joining the nuclei, and are given the same designation:  $\sigma$  bond ( $\sigma$  = sigma).

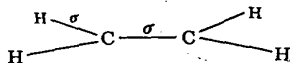


FIGURE 4.2. Ethylene molecule: only  $\sigma$  bonds shown.

The molecule is not yet complete, however. In forming the  $sp^2$  orbitals, each carbon atom has used only two of its three  $p$  orbitals. The remaining  $p$  orbital consists of two equal lobes, one lying above and the other lying below the plane of the three  $sp^2$  orbitals (Figure 4.3); it is occupied by a single electron. If the  $p$  orbital of one carbon atom overlaps the  $p$  orbital of the other carbon atom, the electrons pair up and an additional bond is formed.

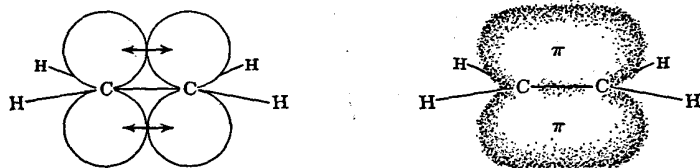


FIGURE 4.3. Ethylene molecule: carbon-carbon double bond. Overlap of  $p$  orbitals gives  $\pi$  bond;  $\pi$  cloud above and below plane.

Because it is formed by the overlapping of  $p$  orbitals, and to distinguish from the differently shaped  $\sigma$  bonds, this bond is called a  $\pi$  bond ( $\pi$  = pi). It consists of two parts, one electron cloud that lies above the plane of the

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atoms, and another electron cloud that lies below. Because of less overlapping, the  $\pi$  bond is weaker than the carbon-carbon  $\sigma$  bond. As we can see from Figure 4.3, this overlapping can occur only when all six atoms lie in the same plane. Ethylene, then, is a *flat molecule*.

The carbon-carbon "double bond" is thus made up of a strong  $\sigma$  bond (about 60 kcal) and a weak  $\pi$  bond (about 40 kcal). The total bond strength of 100 kcal is greater than that of the carbon-carbon single bond of ethane (83 kcal). Since the carbon atoms are held more tightly together, the C—C distance in ethylene is less than the C—C distance in ethane; that is to say, the carbon-carbon double bond is shorter than the carbon-carbon single bond.

This quantum mechanical structure of ethylene is verified by direct evidence. Electron diffraction and spectroscopic studies show ethylene (Figure 4.4) to be a flat molecule, with bond angles very close to  $120^\circ$ . The C—C distance is 1.34 Å as compared with the C—C distance of 1.54 Å in ethane.

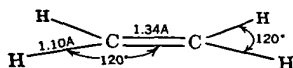


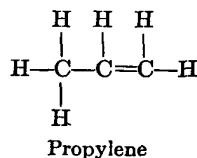
FIGURE 4.4. Ethylene molecule: shape and size.

In addition to these direct measurements, we shall soon see that two important aspects of alkene chemistry are consistent with the quantum mechanical picture of the double bond, and are most readily understood in terms of that picture. These are (a) the concept of *hindered rotation* and the accompanying phenomenon of *geometric isomerism* (Sec. 4.5), and (b) the kind of reactivity characteristic of the carbon-carbon double bond (Sec. 5.2).

**Problem 4.1** Compare the electronic configurations of  $\text{BF}_3$ , which is a flat, triangular molecule (check your answer to Problem 1.4, page 16), and  $\text{NF}_3$ , which is pyramidal.

### 4.3 Propylene

The next member of the alkene family is **propylene**,  $\text{C}_3\text{H}_6$ . In view of its great similarity to ethylene, it seems reasonable to assume that this compound, too, contains a carbon-carbon double bond. Starting with two carbons joined by a double bond, and attaching the other atoms according to our rule of one bond per hydrogen and four bonds per carbon, we arrive at the structure



### 4.4 The butylenes

Going on to the **butylenes**,  $\text{C}_4\text{H}_8$ , we find that there are a number of possible arrangements. First of all, we may have a straight-chain skeleton

## Chapter five

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# ALKENES II. REACTIONS OF THE CARBON-CARBON DOUBLE BOND

### 5.1 The functional group

The characteristic feature of the alkene structure is the carbon-carbon double bond. The characteristic reactions of an alkene are those that take place at the double bond. *The atom or group of atoms that defines the structure of a particular family of organic compounds and, at the same time, determines their properties is called the functional group.*

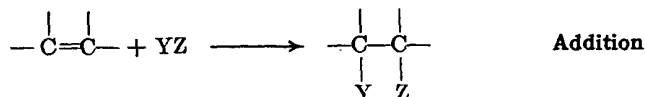
In alkyl halides the functional group is the halogen atom, and in alcohols the  $\text{—OH}$  group; in alkenes it is the carbon-carbon double bond. We must not forget that an alkyl halide, alcohol, or alkene has alkyl groups attached to these functional groups; under the proper conditions, the alkyl portions of these molecules undergo the reactions typical of alkanes. However, the reactions that are *characteristic* of each of these compounds are those that occur at the halogen atom or the hydroxyl group or the carbon-carbon double bond.

A large part of organic chemistry is therefore the chemistry of the various functional groups. We shall learn to associate a particular set of properties with a particular group wherever we may find it. When we encounter a complicated molecule, which contains a number of different functional groups, we may expect the properties of this molecule to be roughly a composite of the properties of the various functional groups. The properties of a particular group may be modified, of course, by the presence of another group and it is important for us to understand these modifications, but our point of departure is the chemistry of individual functional groups.

### 5.2 Reactions of the carbon-carbon double bond: addition

Alkene chemistry is the chemistry of the carbon-carbon double bond.

What kind of reaction may we expect of the double bond? The double bond consists of a strong  $\sigma$  bond and a weak  $\pi$  bond; we might expect, therefore, that reaction would involve the breaking of this weaker bond. This expectation is correct: the typical reactions of the double bond are of the sort,



where the  $\pi$  bond is broken and two strong  $\sigma$  bonds are formed in its place.

A reaction in which two molecules combine to yield a single molecule of product is called an **addition reaction**. The reagent is simply added to the organic molecule, in contrast to a substitution reaction where part of the reagent is *substituted* for a portion of the organic molecule. Addition reactions are necessarily limited to compounds that contain atoms sharing more than one pair of electrons, that is, to compounds that contain multiply-bonded atoms.

What kind of reagent may we expect to add to the carbon-carbon double bond? In our structure of the bond there is a cloud of  $\pi$  electrons above and below the plane of the atoms (see Figure 5.1).

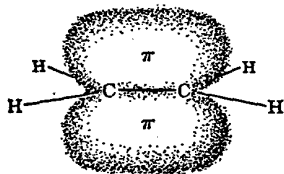


FIGURE 5.1. Carbon-carbon double bond:  $\pi$  bond is source of electrons.

These  $\pi$  electrons are less involved than the  $\sigma$  electrons in holding together the carbon nuclei. As a result, they are themselves held less tightly. These loosely held  $\pi$  electrons are particularly available to a reagent that is seeking electrons. It is not surprising, then, that in most of its reactions the carbon-carbon double bond serves as a **source of electrons**: that is, it acts as a **base**. The compounds with which it chiefly reacts are those that are deficient in electrons, that is, are **acids**. These acidic, electron-seeking reagents are called **electrophilic reagents** (from the Greek, electron-loving). The typical reaction of an alkene is **electrophilic addition**, or in other words, addition of acidic reagents.

Most alkenes contain not only the carbon-carbon double bond but also alkyl groups, which have essentially the alkane structure. Besides the electrophilic addition characteristic of the carbon-carbon double bond, therefore, alkenes may undergo the free radical substitution characteristic of alkanes. The most important of these addition and substitution reactions are summarized below, and will be discussed in detail in following sections.

The alkyl groups attached to the doubly-bonded carbons modify the reactions of the double bond; the double bond modifies the reactions of the alkyl groups. We shall be concerned with seeing what these modifications are, and where possible how they can be accounted for.

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